MAIL STOP APPEAL
BRIEF - PATENTS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	M.R. Toland	Attorney Docket No. WEYE121907/22822C
Application No.:	10/680,676	Art Unit: 1651 / Confirmation No. 5444
Filed:	October 7, 2003	Examiner: L.B. Lankford, Jr.
Title:	METHODS FOR CLASSIFICATION OF SOMATIC EMBRYOS	

TRANSMITTAL OF APPEAL BRIEF

Seattle, Washington 98101

November 21, 2005

TO THE COMMISSIONER FOR PATENTS:

Enclosed herewith for filing in the above-identified application is an Appeal Brief. Also enclosed is our Check No. 167331 in the amount of $500. The Commissioner is hereby authorized to charge any fees under 37 C.F.R. §§ 1.16, 1.17 and 1.18 which may be required during the entire pendency of the application, or credit any overpayment, to Deposit Account No. 03-1740. This authorization also hereby includes a request for any extensions of time of the appropriate length required upon the filing of any reply during the entire prosecution of this application. A copy of this sheet is enclosed.

Respectfully submitted,

CHRISTENSEN O'CONNOR
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Date: November 21, 2005 Janet M. Bedrine

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BRIEF - PATENTS

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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

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Application No:	10/680,676	Group Art Unit:	1651
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Title: METHODS FOR CLASSIFICATION OF SOMATIC EMBRYOS

APPELLANT'S APPEAL BRIEF

Seattle, Washington

November 21, 2005

TO THE COMMISSIONER FOR PATENTS:

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TABLE OF CONTENTS

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I. REAL PARTY IN INTEREST

The real party in interest is Weyerhaeuser Company, a Washington corporation, having a principal place of business at 33663 Weyerhaeuser Way South, Federal Way, Washington 98003. Assignment of the present patent application and the invention from the parties named in the application to the real party in interest was recorded at Reel 011948, Frame 0513.

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II. RELATED APPEALS AND INTERFERENCES

This application is a divisional of Application No. 09/700,037. Another divisional Application No. 10/680,675 was also filed based on Application No. 09/700,037. Both Application Nos. 09/700,037 and 10/680,675 were finally rejected on June 20, 2005 and appealed. Appellant's Appeal Brief in each of these cases is concurrently filed with the present Brief.

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III. STATUS OF CLAIMS

Claims 1-14 are pending in this case. All Claims 1-14 have been finally rejected in the final Office Action mailed June 20, 2005, and appealed.

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IV. STATUS OF AMENDMENTS

There are no outstanding amendments to this application.

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V. SUMMARY OF CLAIMED SUBJECT MATTER

Claim 1 is the only independent claim pending in the present application.

Claim 1 is directed to a method for classifying plant embryos according to their quantifiable characteristics, such as their potential to successfully germinate and grow into normal plants, based on digital image data obtained from the plant embryos. The method involves generally four steps. First, raw digital image data are obtained from reference plant embryos of known quantifiable characteristics. In a simple case, the reference plant embryos of known quantifiable characteristics are divided into two groups: those that are known to have favorable quantifiable characteristics, e.g., those that are likely to geminate and grow into normal plants; and those that are known to have unfavorable quantifiable characteristics, e.g., those that are unlikely to germinate and grow into normal plants. (Their quantifiable characteristics are known based on a follow-up study, for example.) Thus, each set of the raw digital image data obtained from each reference plant embryo is correlated to the known quantifiable characteristics of that reference plant embryo.

Second, a single metric classification model is developed, using generally four sub-steps. In step (1), a metric value is calculated from the acquired raw digital image data of each embryo of known quantifiable characteristics. "Metrics" refers to "any scalar statistical value that captures geometric, color, or spectral features which contains information about the embryos, such as central and non-central moments, function of the spectral energy at specific wavelengths or any function of one or more of these statistics." (Page 10, lines 8-11 of the specification.) In step (2), the metric values obtained above are divided into two sets of metric values according to their known quantifiable characteristics. In step (3), a Lorenz curve is calculated from the two sets of metric values. In step (4), any point on the Lorenz curve calculated above is used as a threshold value to arrive at a single metric classification model for classifying plant embryos by

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their quantifiable characteristics. (Page 17, line 18 through page 18, line 31 of the specification.) The Lorenz curve and its threshold value, found as described above, can be used to form a "single metric classification model," in which "values of a metric less than its threshold are assigned to one embryo quality [e.g., having desirable quantifiable characteristics] and values greater than the threshold are assigned to the other embryo quality class [e.g., having undesirable quantifiable characteristics]. (page 17, lines 33-35.)

Third, raw digital image data are obtained from plant embryos of *unknown* quantifiable characteristics.

Fourth, the single metric classification model developed above is applied to the raw digital image data of embryos of unknown quantifiable characteristics, to thereby classify those plant embryos of unknown quantifiable characteristics according to their *presumed* quantifiable characteristics. (Page 17, line 18 through page 18, line 31 of the specification.)

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VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

In the final Office Action mailed June 20, 2005, all pending claims (Claims 1-14) were finally rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Further, all the claims were found to contain subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claims 1-14 were also rejected under 35 U.S.C. § 103(a) as being obvious over Chi et al. (*J of Fermentation and Bioengineering* Vol 81 (5)) and /or Vits et al. (*AIChE Journal* Vol 40(10)).

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VII. ARGUMENT

Appellant respectfully submits that the Examiner's rejection of the present application under 35 U.S.C. § 112, first paragraph, under 35 U.S.C. § 102(b), and under 35 U.S.C. § 103(a), was in error, and should be reversed.

1. The Specification as Filed Clearly Meets the Written Description and Enablement Requirements Under Section 112, First Paragraph.

The Examiner has rejected Claims 1-14 under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s) had possession of the claimed invention. Further, the Examiner has found that the subject matter recited in Claims 1-14 was not described in the specification in such a way as to enable one skilled in the art to make and/or use the invention.

More specifically, the Examiner found as follows:

> Applicant claims a method for classifying plant embryo's 'quantifiable characteristics,' yet within the specification as originally filed, there is no clear correlation drawn between the data collected and compared and the desired 'quantifiable characteristics' of an embryo. Applicant has not clearly established what the correlation is and thus it is unclear that applicant actually had within their possession a method for actually classifying plant embryos....
>
> It follows logically that the claimed invention has not been enabled by the instant specification because applicant has not taught how to classify embryos *wherein the 'raw spectral data' of an embryo with desired "quantifiable characteristics" is used as a standard to which embryos of unknown quality are compared* wherein if the data matches(?) then the unknown is classified as having desired quantifiable characteristics which would appear to be applicant's invention. The specification shows no correlation between 'raw digital image data' and the desired characteristics but only between 'raw digital image data' of one embryo and 'raw digital image data' of a subsequent embryo.
>
> It would appear that applicant is claiming that if an unknown embryo has the same 'raw digital image data' as the reference embryo then it has the same desired

> quantifiable characteristics but applicant has not set forth how a different result is to be classified. Thus applicant has not described or enabled how to classify an embryo. *What parameters or data would show that an embryo is of lesser desired quantifiable characteristics? Greater desired quantifiable characteristics?* There appears to be no indication of how the reference and model are used to classify the embryos of a desired quantifiable characteristic(s).
>
> (Final Office Action, pages 4-5, emphasis added.)

As a preliminary matter, it is noted that the Examiner appears to have misunderstood the present invention as directed to directly comparing the raw digital image data of a reference embryo and the raw digital image data of an embryo having unknown characteristics. To the contrary, as discussed above, the present invention is directed to developing a *single metric classification model* by processing the raw digital image data collected from plural reference embryos, and then *applying the developed single metric classification model* to the raw digital image data of an embryo of unknown quantifiable characteristics.

In the above-quoted language, the Examiner appears to be asserting that the present specification has not clearly described a specific (or universal) correlation between the acquired raw digital image data from plant embryos and their quantifiable characteristics. In other words, the Examiner appears to be objecting to that the specification did not identify a particular set of "parameters or data" that can always be used as reliable indicators of specific quantifiable characteristics. For example, the Examiner appears to be demanding that the specification includes a specific correlation statement, such as "if a plant embryo has length X and width Y, then the embryo is deemed as likely to successfully germinate."

Appellant respectfully submits that the present invention is *not* directed to requiring to first identify a particular set of parameters or data that can be always used as indicative of specific quantifiable characteristics of plant embryos. To the contrary, the present invention is directed to developing a single metric classification model by: (i) acquiring raw digital image data of reference embryos of known quantifiable characteristics; (ii) calculating a metric value

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from the acquired raw digital image data of each embryo of known quantifiable characteristics; (iii) dividing the metric values obtained above into two sets of metric values according to their known quantifiable characteristics; (iv) calculating a Lorenz curve from the two sets of metric values; and (v) using any point on the Lorenz curve calculated above as a threshold value to arrive at a single metric classification model for classifying plant embryos by their quantifiable characteristics. Therefore, different single metric classification models are developed based on different sets of reference embryos, respectively.

Accordingly, appellant respectfully submits that the lack of disclosure of particular parameters or data that indicate specific quantifiable characteristics in this case does not raise any issue under 35 U.S.C. § 112, first paragraph, because the present invention as claimed is *not* directed to requiring to identify such parameters or data.

Appellant further respectfully submits that the specification clearly describes the present invention directed to how a single metric classification model is developed based on data acquired from reference embryos of known quantifiable characteristics, and then is used to classify embryos of unknown quantifiable characteristics according to their presumed quantifiable characteristics. (See, for example, page 17, line 18 through page 18, line 31 of the specification.) A specific example of the present invention is further recited at page 25, line 21 through page 31, line 10, wherein Tables 4, 5, and 6 each explicitly shows the results of classifying embryos by using a Lorenz Curve classification method in accordance with the present invention of Claim 1. Still further, the Declaration filed in the present case on March 15, 2005, by inventor Toland sets forth facts that establish that the inventor had in his possession the invention as recited in Claims 1-14 of the present application.

In the final Office Action, the Examiner particularly rejected Claim 14 under § 112, first paragraph, noting that "there appears to be no adequate description for the specific qualities

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applicant claims in Claim 14." (Office Action, page 5, third paragraph.) Appellant notes that each and every example of quantifiable characteristics recited in Claim 14 is explicitly described in page 6, line 37 to page 7, line 7 of the application as filed.

Based on the foregoing, appellant respectfully submits that, contrary to the Examiner's finding, the specification as filed clearly describes the invention as claimed. Accordingly, appellant asserts that it is clear, in view of the specification as filed, that the inventor was in possession of the invention of Claims 1-14 directed to a method of classifying plant according to their quantifiable characteristics based on a single metric classification model. The specification describes how such a single metric classification model is developed and used. The first paragraph of § 112 does not require that a specific *universal* example of a single metric classification model be described. Rather, one skilled in the art reading the present specification would recognize that the inventor had in his possession, at the time of filing, the invention directed to a method for classifying plant embryos according to their quantifiable characteristics comprising the steps recited in Claims 1-14. For the same reasons, one skilled in the art reading the present specification would be enabled to practice the present invention. Accordingly, the Examiner's rejection of Claims 1-14 under 35 U.S.C. § 112, first paragraph was in error.

2. Claims 1-14 are Nonobvious in view of Chi et al. and/or Vits et al. Under Section 103.

Claims 1-14 stand rejected under 35 U.S.C. § 103(a) as being obvious over Chi et al. (*J of Fermentation and Bioengineering* Vol 81 (5)) and /or Vits et al. (*AIChE Journal* Vol 40(10)). Appellant respectfully submits that the rejection in view of Chi et al. and/or Vits et al. was also in error, and submits the following arguments.

As discussed above, the present invention is directed to a method for classifying plant embryos according to their quantifiable characteristics, including generally four steps. First, raw digital image data are obtained from reference samples of plant embryos of known quantifiable

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characteristics. Second, a single metric classification model is developed based on the raw digital image data. Specifically, a single metric classification model is developed by: (i) calculating a metric value from the acquired raw digital image data of each embryo of known quantifiable characteristics; (ii) dividing the metric values obtained above into two sets of metric values according to their known quantifiable characteristics; (iii) calculating a Lorenz curve from the two sets of metric values; and (iv) using any point on the Lorenz curve calculated above as a threshold value to arrive at a single metric classification model for classifying plant embryos by their quantifiable characteristics. Third, raw digital image data are obtained from a plant embryo of unknown quantifiable characteristics. Fourth, the developed single metric classification model is applied to the digital image data of the plant embryo of unknown quantifiable characteristics to classify the embryo according to its presumed quantifiable characteristics.

On the other hand, Chi et al. and Vits et al. are *completely* silent as to the development of a single metric classification model by calculating a Lorenz curve and using any point on the Lorenz curve as a threshold value.

Specifically, Chi et al. propose to classify embryos based on "Fourier and size features" of an embryo. (Abstract.) Chi et al., after imaging each embryo, divide each embryo contour into 32 equal-length segments to give rise to 32 Fourier features, and consider those 32 Fourier and size features in classifying embryos. (Page 447, first column, second full paragraph, to second column. See also Figure 2.) Likewise, Vits et al. employ "size and size-independent morphological descriptors" in classifying embryos (Abstract). Like Chi et al., Vits et al. use "32 arc-length intervals" (Figure 2) in evaluating an embryo image. Neither Chi et al. or Vits et al. describe a method of classifying plant embryos based on a single metric classification model developed by calculating a Lorenz curve and using any point on the Lorenz curve as a threshold value.

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The Examiner apparently concedes this point, and thus makes a conclusive statement that to the extent that the subject matter of Claim 1 is not taught by Chi et al. and/or Vits et al., "the applicant uses known algorithms and programs to analyze the data and the use of such mathematic means would have been obvious." (Office Action, page 6.)

Appellant respectfully points out that the Examiner has not identified any prior art teaching related to calculation of Lorenz curves and their use as single metric classification models for classifying plant embryos, as disclosed and claimed in the present application. As explained in the present specification, Lorenz curves were developed to compare income distribution among different groups of people. Such Lorenz curves were created by plotting the fraction of income versus the fraction of the population that owns that fraction of the income. These applications of Lorenz curves do *not* at all teach or suggest "using any point on the Lorenz curve ... as a threshold value to arrive at a single metric classification model for classifying plant embryos by their quantifiable characteristics," as explicitly recited in Claim 1.

In summary, neither Chi et al. or Vits et al. teach or suggest the concept of the present invention as recited in Claim 1, and further, the Examiner has not identified any prior art teaching related to calculation of Lorenz curves and use of any points on the Lorenz curves as threshold values to arrive at single metric classification models for classifying plant embryos, as recited in Claim 1. Since the teaching directed to this aspect of Claim 1 is therefore *completely* missing in each of Chi et al., Vits et al., and the general knowledge in the art that the Examiner could point to, no *prima facie* case of obviousness has been made in the present case.

Accordingly, appellant respectfully submits that the rejection of Claim 1 under 35 U.S.C. § 103(a) in view of Chi et al. and/or Vits et al. was in error, and Claim 1 is allowable. Appellant further respectfully submits that dependent Claims 2-14 are also believed to be allowable for at least the same reasons why independent Claim 1 is allowable.

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VIII. CLAIMS APPENDIX

1. A method for classifying plant embryos according to their quantifiable characteristics comprising:

(a) developing a single metric classification model by

(i) acquiring raw digital image data of reference samples of whole plant embryos or any portion thereof of known quantifiable characteristics;

(ii) calculating a metric value from the acquired raw digital image data of each embryo of known quantifiable characteristics;

(iii) dividing the metric values obtained in step (a)(ii) into two sets of metric values according to their known quantifiable characteristics;

(iv) calculating a Lorenz curve from the two sets of metric values;

(v) using any point on the Lorenz curve calculated in step (a)(iv) as a threshold value to arrive at a single metric classification model for classifying plant embryos by their quantifiable characteristics;

(b) acquiring raw digital image data of a whole plant embryo or any portion thereof of unknown quantifiable characteristics; and

(c) applying the developed single metric classification model to the raw digital image data of step (b) in order to classify the plant

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embryo of unknown quantifiable characteristics according to its presumed quantifiable characteristics.

2. A method according to Claim 1, wherein two or more single metric classification models derived from different metrics are combined using one or more classification algorithms to develop a classification model for classifying plant embryos.

3. A method according to Claim 1, wherein the raw digital image data acquired in step (a)(i) is preprocessed using one or more preprocessing algorithms before step (a)(ii); the raw digital image data acquired in step (b) is preprocessed using one or more preprocessing algorithms; and step (c) is carried out using the preprocessed raw digital image data.

4. A method according to Claim 3, wherein the preprocessing algorithm removes raw image data that is not from the plant embryo or plant embryo organ.

5. A method according to Claim 3, wherein the preprocessing algorithm reduces the amount of raw image data.

6. A method according to Claim 1, wherein the raw digital image data is acquired from more than one view of the plant embryo or plant embryo organ.

7. A method according to Claim 1, wherein the quantifiable characteristics comprise morphology.

8. A method according to Claim 1, wherein the quantifiable characteristics comprise embryo conversion potential.

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9. A method according to Claim 1, wherein the plant embryo is a plant somatic embryo.

10. A method according to Claim 9, wherein the plant is a tree.

11. A method according to Claim 10, wherein the tree is a member of the order *Coniferales*.

12. A method according to Claim 10, wherein the tree is a member of the family *Pinaceae*.

13. A method according to Claim 10, wherein the tree is selected from the group consisting of genera *Pseudotsuga* and *Pinus*.

14. The method according to Claim 1 wherein the quantifiable characteristics comprise conversion potential, resistance to pathogens, drought resistance, heat resistance, cold resistance, salt tolerance, preference for light quality, or suitability for long-term storage.

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IX. EVIDENCE APPENDIX

None

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X. RELATED PROCEEDINGS APPENDIX

Copies of the Appellant Briefs concurrently filed in the related divisional applications, Application Nos. 09/700,037 and 10/680,675, are attached herewith.

Respectfully submitted,

CHRISTENSEN O'CONNOR
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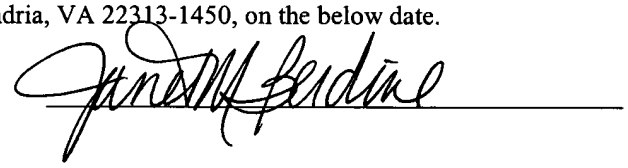
Date: November 21, 2005 

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TABLE OF CONTENTS

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I. REAL PARTY IN INTEREST

The real party in interest is Weyerhaeuser Company, a Washington corporation, having a principal place of business at 33663 Weyerhaeuser Way South, Federal Way, Washington 98003. Assignment of the present patent application and the invention from the parties named in the application to the real party in interest was recorded at Reel 011948, Frame 0513.

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Claim 1 is the only independent claim pending in the present application.

Claim 1 is directed to a method for classifying plant embryos according to their quantifiable characteristics, such as their potential to successfully germinate and grow into normal plants, based on digital image data obtained from the plant embryos. The method involves generally four steps. First, raw digital image data are obtained from reference plant embryos of known quantifiable characteristics. In a simple case, the reference plant embryos of known quantifiable characteristics are divided into two groups: those that are known to have favorable quantifiable characteristics, e.g., those that are likely to geminate and grow into normal plants; and those that are known to have unfavorable quantifiable characteristics, e.g., those that are unlikely to germinate and grow into normal plants. (Their quantifiable characteristics are known based on a follow-up study, for example.) Thus, each set of the raw digital image data obtained from each reference plant embryo is correlated to the known quantifiable characteristics of that reference plant embryo.

Second, one or more classification algorithms are applied to the raw image data acquired from the reference plant embryos to thereby develop a classification model for classifying plant embryos according to their quantifiable characteristics. In developing a classification model, at least one of the classification algorithms is applied to process *more than an embryo perimeter (or contour) from the acquired raw digital image data.* For example, the classification algorithms can be applied to process non-perimeter information, such as "surface texture and color" of an embryo (page 7, lines 7-8 of the specification), to thereby develop a classification model according to the present invention. As will be more fully discussed below, this is in contrast to prior methods that used only the embryo *perimeter* information in developing an embryo classification model.

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Essentially, a "classification model" (or a classifier) is a system that identifies an input by recognizing that the input is a member of one of a number of possible classes. Various classification algorithms are available to develop a classification model. Some non-limiting examples are listed in the specification, at page 7, line 28 - page 8, line 23, and include principal components analysis, artificial neural networks, Bayesian Classifiers, Probably Approximately Correct (PAC) Learning, Radial Basis Functions, Nearest-Neighbor Methods, and the Lorenz curve method. In one example described in the specification, at page 35, line 23 - page 37, line 10, data collected from a set of reference plant embryos of known quantifiable characteristics were subjected to principal component analysis. Principal component analysis, as well known in the classification art, involves a mathematical procedure that transforms a number of (possibly) correlated variables in the original data into a (smaller) number of uncorrelated variables called *principal components*. The first principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible. In other words, the first principal component is the projection on the direction in which the variance of the projection is maximized, and each succeeding component is the projection on the direction in which the remaining variance is maximized. Thus, principal components are "meaningful" variables, in the sense that they are highly indicative of the variance (leading to classification) of the data.

Referring back to the example in the specification, at page 35, line 23 – page 37, line 10, principal component analysis is applied to the data collected from reference plant embryos using a software package, "the Unscrambler," available from Camo ASA and its results are shown in FIGURE 2A. In this example, reference plant embryos were divided into four groups: Douglas-fir zygotic embryos of three different developmental stages (mature dry zygotics – noted as black circles in FIGURE 2A; "August 14" immature zygotics – white triangles; and "July 23" immature

zygotics – black squares) and somatic embryos from Genotype 1 ("+" symbols). FIGURE 2A shows that these four populations of varying embryo quantifiable characteristics can be separated into four clearly distinct groups when plotted with respect to the first three principal components obtained from the principal component analysis. In other words, the data collected from the reference plant embryos and analyzed using principal component analysis are clearly "correlated" to the four populations of varying quantifiable characteristics. Thus, these results are used to form a classification model to classify a plant embryo of unknown embryo quantifiable characteristics.

Third, raw digital image data are obtained from plant embryos of *unknown* quantifiable characteristics.

Fourth, the classification model developed above is applied to the raw digital image data of embryos of unknown quantifiable characteristics, to thereby classify those plant embryos of unknown quantifiable characteristics according to their *presumed* quantifiable characteristics. Continuing to use the example described in FIGURE 2A of the specification, when data are obtained from a plant embryo of unknown quantifiable characteristics (i.e., a plant embryo belonging to one of the four populations in this example), the first three principal components are calculated from the data and are plotted in FIGURE 2A. Depending on where these three principal components are plotted in FIGURE 2A, the plant embryo of unknown quantifiable characteristics, from which the data are obtained, can be classified into one of these four populations of varying embryo quantifiable characteristics.

It should be understood that FIGURE 2 represents merely one example of a classification model, which could be developed in accordance with the present invention. The specification provides other examples, at page 38, line 12 – page 39, line 20. In particular, FIGURE 4A shows two groups of embryos of high-quality appearance ("+") and low-quality appearance (black

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circles) plotted with respect to the first three principal components, and FIGURE 5A shows two groups of embryos of high-quality morphology ("+") and low-quality morphology (black circles), again plotted with respect to the first three principal components. "These results demonstrate that principal component analysis of ... data from somatic embryos having high- and low-quality morphological appearance provides a basis for developing a classification model that will allow somatic embryos to be rapidly categorized with regards to their germination potential." (Specification, page 39, lines 16-20.) In other words, using principal component analysis, data from embryos of known quantifiable characteristics can be "correlated" to their quantifiable characteristics, and the correlation is used to build a classification model for classifying embryos of unknown quantifiable characteristics based on the data obtained from those embryos of unknown quantifiable characteristics.

It should be understood that principal component analysis is merely one example of a classification algorithm that can be applied to data obtained from plant embryos to develop a classification model, and one or more of any other classification algorithms may be used instead.

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VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

In the final Office Action mailed June 20, 2005, all pending claims (Claims 1-14) were finally rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Further, all the claims were found to contain subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claims 1-14 were also rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as being obvious over Chi et al. (*J of Fermentation and Bioengineering* Vol 81 (5)) and /or Vits et al. (*AIChE Journal* Vol 40(10)).

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VII. ARGUMENT

Appellant respectfully submits that the Examiner's rejection of the present application under 35 U.S.C. § 112, first paragraph, under 35 U.S.C. § 102(b), and under 35 U.S.C. § 103(a), was in error, and should be reversed.

1. The Specification as Filed Clearly Meets the Written Description and Enablement Requirements Under Section 112, First Paragraph.

The Examiner has rejected Claims 1-14 under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s) had possession of the claimed invention. Further, the Examiner has found that the subject matter recited in Claims 1-14 was not described in the specification in such a way as to enable one skilled in the art to make and/or use the invention.

More specifically, the Examiner found as follows:

> Applicant claims a method for classifying plant embryo's 'quantifiable characteristics, yet within the specification as originally filed, there is no clear correlation drawn between the data collected and compared and the desired 'characteristic' of an embryo. Applicant has not clearly established what the correlation is and thus it is unclear that applicant actually had within their possession a method for actually classifying plant embryos....
>
> It follows logically that the claimed invention has not been enabled by the instant specification because applicant has not taught how to classify embryos *wherein the 'raw spectral data' of an embryo with desired "quantifiable characteristics" is used as a standard to which embryos of unknown quality are compared* wherein if the data matches(?) then the unknown is classified as having desired quantifiable characteristics which would appear to be applicant's invention. The specification shows *no correlation between 'raw digital image data' of one embryo and 'raw digital image data' of a subsequent embryo.*
>
> It would appear that applicant is claiming that if an unknown embryo has the same 'raw digital image data' as the reference embryo then it has the same desired quantifiable 'characteristics but applicant has not set forth how a different result is

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> to be classified. Thus applicant has not described or enabled how to classify an embryo. *What parameters or data would show that an embryo is of lesser desired quantifiable characteristics? Greater desired quantifiable characteristics?* There appears to be no indication of how the reference and model are used to classify the embryos of a desired quantifiable characteristic(s).
>
> (Final Office Action, pages 4-5, emphasis added.)

As a preliminary matter, it is noted that the Examiner appears to have misunderstood the present invention as directed to directly comparing the raw digital image data of a reference embryo and the raw digital image data of an embryo having unknown characteristics. To the contrary, as discussed above, the present invention is directed to developing a *classification model* by applying one or more classification algorithms to the raw digital image data collected from plural reference embryos, and then *applying the developed classification model* to the raw digital image data of an embryo of unknown quantifiable characteristics.

In the above-quoted language, the Examiner appears to be asserting that the present specification has not clearly described a specific (or universal) correlation between the acquired raw digital image data from plant embryos and their quantifiable characteristics. In other words, the Examiner appears to be objecting to that the specification did not identify a particular set of "parameters or data" that can always be used as reliable indicators of specific quantifiable characteristics. For example, the Examiner appears to be demanding that the specification includes a specific correlation statement, such as "if a plant embryo has length X and width Y, then the embryo is deemed as likely to successfully germinate."

Appellant respectfully submits that the present invention is *not* directed to requiring to first identify a particular set of parameters or data that can be always used as indicative of specific quantifiable characteristics of plant embryos. Such an approach had been tried in the past prior to the present invention. Specifically, as described in the background section of the present application, "[it] has been proposed to use some form of instrumental image analysis for

embryo selection.... All of these methods require considerable *pre-judgment* of which morphological features are important and the development of mathematical methods to extract this information from the image. Relatively little of the information from the image has actually been used." (Specification, page 2, lines 13-22.) In other words, all of these prior methods required first identifying what parameters or data are indicative of specific quality of plant embryos, and used only those limited number of parameters or data. More specifically, as will be more fully described below, these methods first identified the embryo *perimeter* information, such as the perimeter (contour) shape and size, as indicative of a specific embryo quality, and thus analyzed only the embryo perimeter information in classifying embryos.

To the contrary, the present invention is directed to developing a classification model by applying one or more classification algorithms to the raw digital image data of reference sample embryos of known quantifiable characteristics, without requiring first identifying what parameters or data are indicative of specific quantifiable characteristics. Specifically, according to the present invention, "at least one of the classification algorithms uses more than an embryo perimeter from the acquired raw digital image data," as recited in Claim 1. In other words, the method of the present invention requires no pre-judgment that only the embryo perimeter information is indicative of embryo quality, and instead uses non-perimeter information also, such as texture, color, and any pattern contained in the non-perimeter pixels of an embryo image, in developing a classification model (See, page 7, lines 7-8 of the specification.) Therefore, different classification models are developed based on different sets of reference embryos, respectively.

Accordingly, appellant respectfully submits that the lack of disclosure of particular parameters or data that indicate specific quantifiable characteristics in this case does not raise any

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issue under 35 U.S.C. § 112, first paragraph, because the present invention as claimed is *not* directed to requiring to identify such parameters or data.

Appellant further respectfully submits that the specification clearly describes the present invention directed to how a classification model is developed based on data acquired from reference embryos of known quantifiable characteristics, and then is used to classify embryos of unknown quantifiable characteristics according to their presumed quantifiable characteristics, as described in the summary section above. Some specific examples of the invention are provided at page 13, line 1 through page 33, line 10 of the specification. ("Examples 1-4".) These examples describe how digital image data are acquired for plant embryos of known quantifiable characteristics; how training sets are used in classification algorithms to develop a classification model; how digital image data are obtained from a plant embryo of unknown quantifiable characteristics; and how the classification model is applied to the data from a plant embryo of unknown quantifiable characteristics to classify the embryo. Still further, the Declaration filed in the present case on March 15, 2005, by inventors Timmis, Toland, Carlson, Grob, and Ghermay sets forth facts that establish that the inventors had in their possession the invention as recited in Claims 1-14 of the present application.

In the final Office Action, the Examiner particularly rejected Claim 14 under § 112, first paragraph, noting that "there appears to be no adequate description for the specific qualities applicant claims in Claim 14." (Office Action, page 5, third paragraph.) Appellant notes that each and every example of quantifiable characteristics recited in Claim 14 is explicitly described in page 7, lines 11-19 of the application as filed.

Based on the foregoing, appellant respectfully submits that, contrary to the Examiner's finding, the specification as filed clearly describes the invention as claimed. Accordingly, appellant asserts that it is clear, in view of the specification as filed, that the inventors were in

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possession of the invention of Claims 1-14 directed to a method of classifying plant embryos according to their quantifiable characteristics. The specification describes how a classification model is developed and used. The first paragraph of § 112 does not require that a specific *universal* example of a classification model be described. Rather, one skilled in the art reading the present specification would recognize that the inventors had in their possession, at the time of filing, the invention directed to a method for classifying plant embryos according to their quantifiable characteristics comprising the steps recited in Claims 1-14. For the same reasons, one skilled in the art reading the present specification would be enabled to practice the present invention. Accordingly, the Examiner's rejection of Claims 1-14 under 35 U.S.C. § 112, first paragraph was in error.

2. Claims 1-14 are Novel and Nonobvious in view of Chi et al. and/or Vits et al. Under Section 102 and Section 103.

Claims 1-14 stand rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as being obvious over Chi et al. (*J of Fermentation and Bioengineering* Vol 81 (5)) and /or Vits et al. (*AIChE Journal* Vol 40(10)). Appellant respectfully submits that the rejection in view of Chi et al. and/or Vits et al. was also in error, and submits the following arguments.

As discussed above, the present invention is directed to a method for classifying plant embryos according to their quantifiable characteristics, including generally four steps. First, raw digital image data are obtained from reference samples of plant embryos of known quantifiable characteristics. Second, a classification model is developed based on the raw digital image data. Significantly, at this point "at least one of the classification algorithms uses more than an embryo perimeter from the acquired raw digital image data." (Claim 1.) For example, referring to page 31 of the specification as filed, Table 5 shows that non-perimeter information, such as "skewness coefficient" and "kurtosis coefficient" of an acquired image data are used by a

classification algorithm, in addition to or in place of perimeter information such as "the perimeter radii from the embryo top view." Third, raw digital image data are obtained from a plant embryo of unknown quantifiable characteristics. Fourth, the developed classification model is applied to the digital image data of the plant embryo of unknown quantifiable characteristics to classify the embryo according to its presumed quantifiable characteristics.

On the other hand, Chi et al. and Vits et al. both describe methods for classifying embryos based on image analysis, which use *only* an embryo perimeter from acquired embryo image data. For example, Chi et al. classify embryos based on "Fourier and size features" of an embryo. (Abstract.) Specifically, Chi et al., after imaging each embryo, divides each embryo *contour* into 32 equal-length segments to give rise to 32 Fourier features, and considers only those 32 Fourier and size features in classifying embryos. (Page 447, first column, second full paragraph, to second column. See also Figure 2, showing 32 points along an "embryo contour.") Likewise, Vits et al. employ "size and size-independent morphological descriptors" in classifying embryos (Abstract), in particular, "*contour discretization methods.*" (See page 1731, Figure 2, (A) and (B), emphasis added.) Like Chi et al., Vits et al. use "32 arc-length intervals" (Figure 2) in evaluating an embryo image. Thus, both Chi et al. and Vits et al. describe methods that use only contour or perimeter information from an acquired embryo image in developing a classification model.

Therefore, neither Chi et al. or Vits et al. teaches or suggest the concept of the present invention as recited in Claim 1, which explicitly recites the step of "performing a data analysis by applying one or more classification algorithms to the acquired raw digital image data, wherein *at least one of the classification algorithms uses more than an embryo perimeter from the acquired raw digital image data.*" (Emphasis added.)

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Accordingly, appellant respectfully submits that the rejection of Claim 1 under 35 U.S.C. § 102(b) or 35 U.S.C. § 103(a) in view of Chi et al. and/or Vits et al. was in error, and Claim 1 is allowable. Since the teaching directed to the use of "more than an embryo perimeter from the acquired raw digital image data" was completely missing in each of Chi et al. and Vits et al., Claim 1 cannot be anticipated by either Chi et al. nor by Vits et al., and further, no *prima facie* case of obviousness was made. Appellant further respectfully submits that dependent Claims 2-14 are also believed to be allowable for at least the same reasons why independent Claim 1 is allowable.

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VIII. CLAIMS APPENDIX

1. A method for classifying plant embryos according to their quantifiable characteristics, comprising:

(a) developing a classification model by

(i) acquiring raw digital image data of reference samples of whole plant embryos or of embryo organs of known quantifiable characteristics;

(ii) performing a data analysis by applying one or more classification algorithms to the acquired raw digital image data, wherein at least one of the classification algorithms uses more than an embryo perimeter from the acquired raw digital image data, the data analysis resulting in development of a classification model for classifying plant embryos by their quantifiable characteristics;

(b) acquiring raw digital image data of a plant embryo or a plant embryo organ of unknown quantifiable characteristics; and

(c) applying the developed classification model to the raw digital image data of step (b) in order to classify the plant embryo of unknown quantifiable characteristics according to its presumed quantifiable characteristics.

2. A method according to Claim 1, wherein the raw digital image data acquired in step (a)(i) is preprocessed using one or more preprocessing algorithms before step (a)(ii); the raw digital image data acquired in step (b) is preprocessed using one or more preprocessing

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algorithms; and step (c) is carried out using the preprocessed raw digital image data.

3. A method according to Claim 2, wherein the preprocessing algorithm removes raw image data that is not from the plant embryo or plant embryo organ.

4. A method according to Claim 2, wherein the preprocessing algorithm reduces the amount of raw image data yet retains substantially all of the embryo or embryo organ geometric information.

5. A method according to Claim 2, wherein the preprocessing algorithm calculates metrics.

6. A method according to Claim 1 wherein the raw digital image data is acquired from more than one view of the plant embryo or plant embryo organ.

7. A method according to Claim 1 wherein the quantifiable characteristics comprise morphology.

8. A method according to Claim 1 wherein the quantifiable characteristics comprise conversion potential.

9. A method according to Claim 1 wherein the plant embryo is a plant somatic embryo.

10. A method according to Claim 1 wherein the plant is a tree.

11. A method according to Claim 10 wherein the tree is a member of the order Coniferales.

12. A method according to Claim 10 wherein the tree is a member of the family *Pinaceae*.

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13. A method according to Claim 10 wherein the tree is selected from the group consisting of genera *Pseudotsuga* and *Pinus*.

14. The method of Claim 1 wherein the quantifiable characteristics comprise conversion potential, resistance to pathogens, drought resistance, heat resistance, cold resistance, salt tolerance, preference for light quality, or suitability for long-term storage.

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IX. EVIDENCE APPENDIX

None

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X. RELATED PROCEEDINGS APPENDIX

Copies of the Appellant Briefs concurrently filed in the related applications, Application Nos. 09/700,037 and 10/680,676, are attached herewith.

Respectfully submitted,

CHRISTENSEN O'CONNOR
JOHNSON KINDNESS[PLLC]

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I hereby certify that this correspondence is being deposited in triplicate with the U.S. Postal Service in a sealed envelope as first class mail with postage thereon fully prepaid and addressed to Mail Stop Appeal Brief - Patents, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on the below date.

Date: November 21, 2005

SIL:jam/ejh

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MAIL STOP APPEAL

BRIEF - PATENTS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Applicant:	R. Timmis et al.	Attorney Docket No. WEYE116514/22822A
Application No:	09/700,037	Group Art Unit: 1651
Filed:	July 2, 2001	Examiner: L.B. Lankford, Jr.
Title:	METHODS FOR CLASSIFICATION OF SOMATIC EMBRYOS	

APPELLANT'S APPEAL BRIEF

Seattle, Washington

November 21, 2005

TO THE COMMISSIONER FOR PATENTS:

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MAIL STOP APPEAL

BRIEF - PATENTS

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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

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Application No:	09/700,037	Group Art Unit:	1651
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Title: METHODS FOR CLASSIFICATION OF SOMATIC EMBRYOS

APPELLANT'S APPEAL BRIEF

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TO THE COMMISSIONER FOR PATENTS:

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TABLE OF CONTENTS

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I. REAL PARTY IN INTEREST

The real party in interest is Weyerhaeuser Company, a Washington corporation, having a principal place of business at 33663 Weyerhaeuser Way South, Federal Way, Washington 98003. Assignment of the present patent application and the invention from the parties named in the application to the real party in interest was recorded at Reel 011948, Frame 0513.

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II. RELATED APPEALS AND INTERFERENCES

Two divisional applications have been filed based on the present application--Application Nos. 10/680,675 and 10/680,676, both filed on October 7, 2003, and both finally rejected on June 20, 2005. On September 20, 2005, a Notice of Appeal was filed in each of these two cases, and an Appellant's Appeal Brief in each of these cases is concurrently filed with the present Brief.

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III. STATUS OF CLAIMS

Claims 27-41 are pending in this case. All Claims 27-41 have been finally rejected in the final Office Action mailed June 20, 2005, and appealed.

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IV. STATUS OF AMENDMENTS

There are no outstanding amendments to this application.

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V. SUMMARY OF CLAIMED SUBJECT MATTER

Claim 27 is the only independent claim pending in the present application.

Claim 27 is directed to a method for classifying plant embryos according to their quantifiable characteristics, such as their potential to successfully germinate and grow into normal plants, based on *spectral data* obtained from the plant embryos. The method involves generally four steps. First, *spectral data* are obtained from reference plant embryos of known quantifiable characteristics. Spectral data from embryos mean data related to absorption, transmittance, or reflectance of electromagnetic radiation at multiple discrete wavelengths by the embryos, for example, data obtained in NIR (near-infrared) spectroscopy. (Page10, lines 20-21; page 11, lines 26-29 of the specification.) In a simple case, the reference plant embryos of known quantifiable characteristics are divided into two groups: those that are known to have favorable quantifiable characteristics, e.g., those that are likely to geminate and grow into normal plants; and those that are known to have unfavorable quantifiable characteristics, e.g., those that are unlikely to germinate and grow into normal plants. (Their quantifiable characteristics are known or ascertained based on a follow-up study, for example.) Thus, each spectral data set obtained from each reference plant embryo is correlated to the known quantifiable characteristics of that reference plant embryo.

Second, one or more classification algorithms are applied to the spectral data sets, each being correlated to the known quantifiable characteristics of the reference plant embryo from which the data set is obtained, to develop a classification model for classifying plant embryos according to their presumed quantifiable characteristics. Essentially, a "classification model" (or a classifier) is a system that identifies an input by recognizing that the input is a member of one of a number of possible classes. Various classification algorithms are available to develop a classification model. Some non-limiting examples are listed in the specification, at page 8, line 15 - page 9, line 8, and

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include principal components analysis, artificial neural networks, Bayesian Classifiers, Probably Approximately Correct (PAC) Learning, Radial Basis Functions, Nearest-Neighbor Methods, and the Lorenz curve method. In one example described in the specification, at page 37, line 13 - page 38, line 10, an NIR (near infrared) spectroscopic setup was used to collect spectral data from a set of reference plant embryos of known quantifiable characteristics, and the collected spectral data were subjected to principal component analysis. Principal component analysis, as well known in the classification art, involves a mathematical procedure that transforms a number of (possibly) correlated variables in the original data into a (smaller) number of uncorrelated variables called *principal components*. The first principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible. In other words, the first principal component is the projection on the direction in which the variance of the projection is maximized, and each succeeding component is the projection on the direction in which the remaining variance is maximized. Thus, principal components are "meaningful" variables, in the sense that they are highly indicative of the variance (leading to classification) of the data.

Referring back to the example in the specification, at page 38, line 11 - page 39, line 9, principal component analysis is applied to the spectral data collected from reference plant embryos using a software package, "the Unscrambler," available from Camo ASA and its results are shown in FIGURE 2A. In this example, reference plant embryos were divided into four groups: Douglas-fir zygotic embryos of three different developmental stages (mature dry zygotics - noted as black circles in FIGURE 2A; "August 14" immature zygotics - white triangles; and "July 23" immature zygotics - black squares) and somatic embryos from Genotype 1 ("+" symbols). FIGURE 2A shows that these four populations of varying embryo quantifiable characteristics can be separated into four clearly distinct groups when plotted with respect to the first three principal

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components obtained from the principal component analysis. In other words, the spectral data collected from the reference plant embryos and analyzed using principal component analysis are clearly "correlated" to the four populations of varying quantifiable characteristics. Thus, these results are used to form a classification model to classify a plant embryo of unknown embryo quantifiable characteristics.

Third, spectral raw data are obtained from plant embryos of *unknown* quantifiable characteristics.

Fourth, the classification model is applied to the spectral raw data of embryos of unknown quantifiable characteristics, to thereby classify those plant embryos of unknown quantifiable characteristics according to their *presumed* quantifiable characteristics. Continuing to use the example described in FIGURE 2A of the specification, when spectral data are obtained from a plant embryo of unknown quantifiable characteristics (i.e., a plant embryo belonging to one of the four populations in this example), the first three principal components are calculated from the spectral data and are plotted in FIGURE 2A. Depending on where these three principal components are plotted in FIGURE 2A, the plant embryo of unknown quantifiable characteristics, from which the spectral data are obtained, can be classified into one of these four populations of varying embryo quantifiable characteristics.

It should be understood that FIGURE 2 represents merely one example of a classification model, which could be developed in accordance with the present invention. The specification provides other examples, at page 40, line 7 - page 45, line 14. In particular, FIGURE 4A shows two groups of embryos of high-quality appearance ("+") and low-quality appearance (black circles) plotted with respect to the first three principal components, and FIGURE 5A shows two groups of embryos of high-quality morphology ("+") and low-quality morphology (black circles), again plotted with respect to the first three principal components. "These results demonstrate

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that principal component analysis of spectral data from somatic embryos having high- and low-quality morphological appearance provides a basis for developing a classification model that will allow somatic embryos to be rapidly categorized with regards to their germination potential." (Specification, page 42, lines 19-23.) In other words, using principal component analysis, spectral data from embryos of known quantifiable characteristics can be "correlated" to their quantifiable characteristics, and the correlation is used to build a classification model for classifying embryos of unknown quantifiable characteristics based on the spectral data obtained from those embryos of unknown quantifiable characteristics.

It should be understood that principal component analysis is merely one example of a classification algorithm that can be applied to spectral data obtained from plant embryos to develop a classification model, and one or more of any other classification algorithms may be used instead.

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VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

In the final Office Action mailed June 20, 2005, all pending claims (Claims 27-41) were finally rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Further, all the claims were found to contain subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claims 27-41 were also rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as being obvious over Chi et al. (*J of Fermentation and Bioengineering 81*(5)) and /or Vits et al. (*AIChE Journal 40*(10)).

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VII. ARGUMENT

Appellant respectfully submits that the Examiner's rejection of the present application under 35 U.S.C. § 112, first paragraph, under 35 U.S.C. § 102(b), and under 35 U.S.C. § 103(a), was in error, and should be reversed.

1. The Specification as Filed Clearly Meets the Written Description and Enablement Requirements Under Section 112, First Paragraph.

The Examiner has rejected Claims 27-41 under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s) had possession of the claimed invention. Further, the Examiner has found that the subject matter recited in Claims 27-41 was not described in the specification in such a way as to enable one skilled in the art to make and/or use the invention.

More specifically, the Examiner found as follows:

> Applicant claims a method for classifying plant embryo[s] 'according to their quantifiable characteristics,' yet within the specification as originally filed, there is no clear correlation drawn between the data collected and compared and the desired 'characteristic,' i.e., the ability to germinate, of an embryo. Applicant has not clearly established what the correlation is and thus it is unclear that applicant actually had within their possession a method for actually classifying plant embryo quality....
>
> It follows logically that the claimed invention has not been enabled by the instant specification because applicant has not taught how to classify embryos *wherein the 'spectral data' of an embryo is used as a standard to which embryos of unknown 'characteristics' are compared* wherein if the data matches(?) then the unknown is classified as having the same characteristic which would appear to be applicant's invention. The specification shows no correlation between 'spectral data' and desired characteristics but only between *'the spectral data' of one embryo and 'the spectral data' of a subsequent embryo.*
>
> It would appear that applicant is claiming that if an unknown embryo has the same 'spectral data' as the reference embryo then it has the same desired 'characteristic,'

> i.e. the ability to germinate, but applicant has not set forth how a different result is to be classified. Thus applicant has not described or enabled how to classify an embryo. *What parameters or data would show that an embryo is of lesser desired characteristic? Greater desired characteristic?* There appears to be no indication of how the reference and model are used to classify the desired 'characteristic' of an embryo.
>
> (Final Office Action, pages 3-4, emphasis added.)

As a preliminary matter, it is noted that the Examiner appears to have misunderstood the present invention as directed to directly comparing the spectral data of a reference embryo and the spectral data of an embryo having unknown characteristics. To the contrary, as discussed above, the present invention is directed to developing a *classification model* by applying one or more classification algorithms to the spectral raw data collected from plural reference embryos, and then *applying the developed classification model* to the spectral raw data of an embryo of unknown quantifiable characteristics.

In the above-quoted language, the Examiner appears to be asserting that the present specification has not clearly described a specific (or universal) correlation between the acquired spectral raw data from plant embryos and their quantifiable characteristics. In other words, the Examiner appears to be objecting to that the specification did not identify a particular set of "parameters or data" that can always be used as reliable indicators of specific quantifiable characteristics. For example, the Examiner appears to be demanding that the specification includes a specific correlation statement, such as "if a plant embryo has color X, then the embryo is deemed as likely to successfully germinate."

Appellant respectfully submits that the present invention is *not* directed to requiring to first identify a particular set of parameters or data that can be always used as indicative of specific quantifiable characteristics of plant embryos. Such an approach had been tried in the past prior to the present invention. Specifically, as described in the background section of the present application, "[it] has been proposed to use some form of instrumental image analysis for

embryo selection.... All of these methods require considerable *pre-judgment* of which morphological features are important and the development of mathematical methods to extract this information from the image. Relatively little of the information from the image has actually been used." (Specification, page 2, lines 20-29.) In other words, all of these prior methods required first identifying what parameters or data are indicative of specific quality of plant embryos, and used only those limited number of parameters or data.

To the contrary, the present invention is directed to developing a classification model by applying one or more classification algorithms to the spectral raw data collected from the reference embryos of known quantifiable characteristics, without requiring first identifying what parameters or data are indicative of specific quantifiable characteristics. Therefore, different classification models are developed based on different sets of spectral data obtained from reference embryos, respectively.

Accordingly, appellant respectfully submits that the lack of disclosure of particular parameters or data that indicate specific quantifiable characteristics in this case does not raise any issue under 35 U.S.C. § 112, first paragraph, because the present invention as claimed is *not* directed to requiring to identify such parameters or data.

Appellant further respectfully submits that the specification clearly describes how a classification model is developed, which correlates the acquired spectral data from reference embryos and their known quantifiable characteristics. The specification also clearly describes how the classification model is used to correlate the acquired spectral data from embryos of unknown quantifiable characteristics and their presumed quantifiable characteristics, to thereby classify embryos of unknown quantifiable characteristics according to their presumed quantifiable characteristics. The invention of Claim 27, as summarized above, is broadly described in the specification at page 12, line 27-page 13, line 8.

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More specifically, the specification at page 11, line 26-page 12, line 26 describes how spectral data are acquired for plant embryos of known quantifiable characteristics. The specification at page 13, lines 3-30 describes how training sets are used in classification algorithms to develop a classification model. Reference is made back to the foregoing passages at page 11, line 26-page 12, line 26 and the description of how spectral raw data can be obtained from a plant embryo. This same technique is useful in collecting the spectral data from a plant embryo of unknown embryo quantifiable characteristics. Finally, reference is made to page 12, line 35, through page 13, line 2, and to page 5, lines 19-27, where it is described that the developed classification model is applied to the spectral raw data collected from a plant embryo of unknown quantifiable characteristics to thereby classify the plant embryo of unknown quantifiable characteristics. In particular, the specification includes concrete examples of the method of Claim 27, at page 38, line 3 through page 45, line 14, in reference to FIGURES 2A - 8B. These examples each graphically shows how a classification model was developed using the well-known principal component analysis, as applied to the spectral raw data obtained from plant embryos, to classify embryos into different groups of different quantifiable characteristics. Still further, the Declaration filed on March 15, 2005, by inventors Timmis, Toland, and Ghermay in the present case sets forth facts that establish that a correlation between spectral data and embryo quantifiable characteristics can be established as recited in Claims 27-41.

In the final Office Action, the Examiner particularly rejected Claim 41 under § 112, first paragraph, noting that "there appears to be no adequate description for the specific qualities applicant claims in Claim 41." (Office Action, page 5, second paragraph.) Appellant notes that each and every example of quantifiable characteristics recited in Claim 14 is explicitly described in page 7, lines 28-page 8, line 2 of the application as filed.

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Based on the foregoing, appellant respectfully submits that, contrary to the Examiner's finding, the specification as filed describes the correlation between the spectral data collected from embryos and their "quantifiable characteristics." Accordingly, appellant asserts that it is clear, in view of the specification as filed, that the inventors were in possession of the invention of Claims 27-41 directed to a method of classifying plant embryo according to their quantifiable characteristics. The specification describes how a classification model is developed and used. The first paragraph of § 112 does not require that a specific *universal* example of a classification model be described. Rather, one skilled in the art reading the present application would recognize that the inventors had in their possession, at the time of filing, the method directed to a method for classifying plant embryos according to their quantifiable characteristics comprising the steps recited in Claims 27-41. For the same reasons, one skilled in the art reading the present specification would be enabled to practice the present invention. Accordingly, the Examiner's rejection of Claims 27-41 under 35 U.S.C. § 112, first paragraph was in error.

2. Claims 27-41 are Novel and Nonobvious in view of Chi et al. and/or Vits et al. Under Section 102 and Section 103.

Claims 27-41 stand rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as being obvious over Chi et al. (*J of Fermentation and Bioengineering 81*(5)) and /or Vits et al. (*AIChE Journal 40*(10)). Appellant respectfully submits that the rejection in view of Chi et al. and/or Vits et al. was also in error, and submits the following arguments.

As discussed above, the present invention is directed to a method for classifying plant embryos according to their quantifiable characteristics, including generally four steps. First, *spectral raw data* are obtained from reference samples of plant embryos of known quantifiable characteristics. Second, a classification model is developed based on the application of one or more classification algorithms to the *spectral raw data*. Third, *spectral raw data* are obtained

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from a plant embryo of unknown quantifiable characteristics. Fourth, the developed classification model is applied to the *spectral raw data* of the plant embryo of unknown quantifiable characteristics to thereby classify the embryo according to its presumed quantifiable characteristics.

On the other hand, Chi et al. and Vits et al. both describe methods for classifying embryos based on *image data* (i.e., visible images) obtained from embryos. Specifically, Chi et al. propose to classify embryos based on "Fourier and size features" of an embryo. (Abstract.) Chi et al., after imaging each embryo, divide each embryo contour into 32 equal-length segments to give rise to 32 Fourier features, and consider those 32 Fourier and size features in classifying embryos. (Page 447, first column, second full paragraph, to second column. See also Figure 2, showing the image of an embryo contour consisting of "32 points".) Likewise, Vits et al. employ "size and size-independent morphological descriptors" in classifying embryos (Abstract). Like Chi et al., Vits et al. use "32 arc-length intervals" (Figure 2) in evaluating an embryo image. Therefore, neither Chi et al. or Vits et al. describe a method of classifying plant embryos by developing a classification model based on *spectral data* obtained from plant embryos (such as data obtained in NIR spectroscopy).

The present invention as recited in Claim 27 is directed to a method for developing and using a classification model based on *spectral data* of plant embryos. The method is made possible because differences in spectral data collected from embryos of desirable quantifiable characteristics versus those of undesirable quantifiable characteristics are presumed to reflect differences in chemical composition that are related to embryo quality. (Specification, page 11, lines 29-33.) Chi et al. and Vits et al. are both *completely* silent as to the use of *spectral data* from embryos to develop a classification model, which uncovers subtle relationships between

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spectral data from an embryo and the chemical properties (and hence the quality or quantifiable characteristics) of the embryo.

Accordingly, appellant respectfully submits that the rejection of Claim 27 under 35 U.S.C. § 102(b) or 35 U.S.C. § 103(a) in view of Chi et al. and/or Vits et al. was in error, and Claim 27 is allowable. Since the teaching directed to the use of *spectral data* from embryos to develop and/or apply a classification model was completely missing in each of Chi et al. and Vits et al., Claim 27 cannot be anticipated by either Chi et al. nor by Vits et al., and further, no *prima facie* case of obviousness was made. Appellant further respectfully submits that dependent Claims 28-41 are also believed to be allowable for at least the same reasons why independent Claim 27 is allowable.

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VIII. CLAIMS APPENDIX

1-26. (Canceled)

27. A method for classifying plant embryos according to their quantifiable characteristics comprising:

(a) developing a classification model by

(i) acquiring absorption, transmittance or reflectance spectral raw data of reference samples of plant embryos or any portion thereof of known quantifiable characteristics;

(ii) performing a data analysis by applying one or more classification algorithms to the spectral raw data, the data analysis resulting in development of a classification model for classifying plant embryos by their quantifiable characteristics;

(b) acquiring absorption, transmittance or reflectance spectral raw data of a plant embryo or any portion thereof of unknown quantifiable characteristics; and

(c) applying the developed classification model to the spectral raw data of step (b) in order to classify the plant embryo of unknown quantifiable characteristics according to its presumed quantifiable characteristics.

28. A method according to Claim 27, wherein the absorption, transmittance or reflectance spectral raw data acquired in step (a)(i) is preprocessed using one or more preprocessing algorithms before step (a)(ii); the absorption, transmittance or reflectance spectral raw data acquired in step (b) is preprocessed using one or more preprocessing

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algorithms; and step (c) is carried out using the preprocessed absorption, transmittance or reflectance spectral raw data.

29. A method according to Claim 28, wherein the preprocessing algorithm reduces noise and adjusts for drift and diffuse light scatter.

30. A method according to Claim 28, wherein the preprocessing algorithm reduces the amount of absorption, transmittance or reflectance spectral raw data yet retains substantially all of the spectral information.

31. A method according to Claim 28, wherein the preprocessing algorithm calculates metrics.

32. A method according to Claim 27, wherein the absorption, transmittance or reflectance spectral raw data is acquired from more than one view of the plant embryo or portion thereof.

33. A method according to Claim 27, wherein the absorption, transmittance or reflectance spectral raw data is acquired from one or more embryo regions selected from the group consisting of cotyledon, hypocotyl and radicle.

34. A method according to Claim 27, wherein the quantifiable characteristics comprise morphology.

35. A method according to Claim 27, wherein the quantifiable characteristics comprise embryo conversion potential.

36. A method according to Claim 27, wherein the plant embryo is a plant somatic embryo.

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37. A method according to Claim 27, wherein the plant is a tree.

38. A method according to Claim 37, wherein the tree is a member of the order *Coniferales*.

39. A method according to Claim 37, wherein the tree is a member of the family *Pinaceae*.

40. A method according to Claim 37, wherein the tree is selected from the group consisting of genera *Pseudotsuga* and *Pinus*.

41. The method according to Claim 27, wherein the quantifiable characteristics comprise conversion potential, resistance to pathogens, drought resistance, heat resistance, cold resistance, salt tolerance, preference for light quantifiable characteristics, or suitability for long-term storage.

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IX. EVIDENCE APPENDIX

None

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X. RELATED PROCEEDINGS APPENDIX

Copies of the Appellant Briefs concurrently filed in the related divisional applications, Application Nos. 10/680,675 and 10/680,676, are attached herewith.

Respectfully submitted,

CHRISTENSEN O'CONNOR
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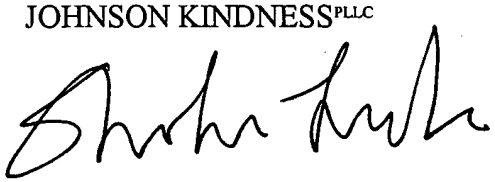

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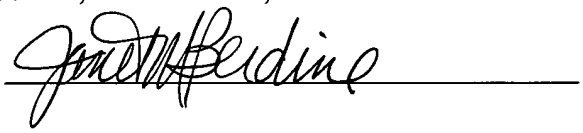
Date: November 21, 2005 

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